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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/229,592	01/13/1999	BRIAN S. DOYLE	42390.P5578	5730

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EXAMINER

BROCK II, PAUL E

ART UNIT

PAPER NUMBER

2815

DATE MAILED: 03/20/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/229,592	DOYLE ET AL.	
	Examiner	Art Unit	
	Paul E Brock II	2815	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 25 January 2002.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-19 and 26-32 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-19 and 26-32 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 13 March 1999 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s). _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449) Paper No(s) <u>21</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Drawings

1. Figures 1a – 1e should be designated by a legend such as --Prior Art-- because only that which is old is illustrated. See MPEP § 608.02(g). A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

3. Claim 28 is rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. It is not clear where in the originally filed specification nickel is disclosed as a metal for forming the silicide layers.

Claim Rejections - 35 USC § 103

4. Claims 1 – 12, 16, 26, 27, 29, 30 and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rodder et al. (USPAT 6063677, Rodder) in view of Sekine et al. (USPAT 5937300, Sekine) and Ishida et al. (USPAT 6051473, Ishida).

Rodder discloses a method of forming a transistor in figures 3a – 5.

In figure 3a Rodder disclose forming an alignment component (120 and 122) on a substrate (102) of a semiconductor material. Rodder discloses in figure 3b and column 3, lines 5 – 40 depositing a metal layer (106) over the substrate. Rodder discloses in column 3, lines 5 – 40 that the metal layer could also be a silicide layer. Rodder discloses in column 3, lines 15 – 16 that the silicide regions are self aligned to the disposable gate. It is an inherent feature of silicide regions that are self aligned to the disposable gate would extend up to the disposable gate and have inner surfaces which face one another. In figures 3e and 3f Rodder discloses removing the alignment component. In figures 3e – 5 and column 5, lines 11 – 26 Rodder discloses replacing the removed alignment component with a conductive gate (112) inherently substantially extending up to the silicide regions. Rodder teaches in column 3, lines 27 – 32 that the silicide regions are formed by the salicide (self-aligned silicide regions) process. Rodder is silent to steps in the salicide process, however, the salicide process is well known in the art. Sekine teaches in figures 13b – 13d the salicide process. Sekine teaches in figure 13b depositing a metal layer (813) over a substrate (801) and an alignment component (805, 804 and 810). Sekine further teaches of reacting the metal layer with the semiconductor material of the substrate to

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form two silicide regions (814) that are self aligned to the alignment component, the silicide regions having inner surfaces which face one another, wherein an upper portion of each inner surface contacts the alignment component and a lower portion of each inner surface contacts the semiconductor material of the substrate. It would have been obvious to one of ordinary skill in the art at the time of the present invention to use the silicide process steps of Sekine that include lower and upper portions of silicide regions in the method of Rodder in order to use a well known and highly understood method of forming the silicide layers that will reduce interconnect resistance of the polysilicon lines. Because Rodder discloses in column 3, lines 15 – 16 that the raised source and drain regions are self aligned to the disposable gate it is further obvious that the silicide regions of the combined method of Rodder and Sekine would produce silicide regions having inner surfaces which face one another, wherein an upper portion of each inner surface contacts the alignment component and a lower portion of each inner surface contacts the semiconductor material of the substrate. Rodder and Sekine do not disclose that the alignment component consists of a single material. Ishida teaches in figures 5a – 5e an alignment component (507) consisting of a single material. It would have been obvious to one of ordinary skill in the art at the time of the present invention to use the alignment component consisting of a single material of Ishida in the method of Rodder and Sekine in order to remove the alignment component in one step as taught by Ishida in figures 5a – 5e and column 6, lines 38 – 59.

With regard to claims 2 – 4, Rodder discloses in columns 2 and 3, lines 59 – 67 and 1- 4 respectively that the alignment component is made of silicon oxide which inherently possesses the properties of being non-conductive, and will not react with the metal layer when the metal layer is reacted with the semiconductor material of the substrate.

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With regard to claims 5, 6 and 8, Rodder discloses in column 2, lines 11 – 17 that the alignment component is less than .10 microns wide. It is inherent that the alignment component has a thickness of between 1000Å and 2500Å. It is inherent that the metal layer is between 300Å and 400Å thick.

With regard to claim 7, Sekine discloses that the metal layer is titanium in column 2, lines 4 – 6.

With regard to claim 9, Sekine discloses in figure 13c that the silicide regions have lower surfaces located lower than a lower surface of the alignment component.

With regard to claim 10, Rodder discloses in figures 3c – 5 a method wherein the alignment component is removed. In figure 3c Rodder discloses depositing a layer (114) over the silicide regions and the alignment component. In column 3, lines 46 – 49 Rodder discloses planarizing the layer at least until the alignment component is exposed. In figures 3e– 5 Rodder discloses etching the alignment component at least until the substrate is exposed to leave an opening between the inner surfaces of the silicide regions to allow for formation of the gate (112).

With regard to claim 11, it would be obvious in the method of Rodder, Sekine and Ishida that after the etching of the alignment component, the upper portions of the inner surfaces would be exposed. Because the alignment component and the upper portions of the inner surfaces are in contact as applied to claim 1, when the alignment component is removed, the upper portions of the inner surfaces would be exposed.

With regard to claim 12, Rodder discloses in columns 2 and 3, lines 59 – 67 and 1 – 52 respectively the alignment component and the layer are made of different materials, one being made of silicon oxide and the other being made of silicon nitride.

With regard to claim 16, Rodder discloses in figure 4 forming doped regions (104) which extend from the silicide regions in underneath the gate.

Claims 26, 27, 29 and 32 is rejected similar to at least claims 1, 4 and 9 – 12, respectively, with regard to Rodder, Sekine and Ishida, above. It is inherent that the silicide regions form a Schottky junction.

With regard to claim 30, it is further obvious in the method of Rodder, Sekine and Ishida that a portion of the metal layer above the alignment component is removed after the metal layer is reacted with the semiconductor material of the substrate.

5. Claims 13 – 15 and 31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rodder, Sekine and Ishida as applied to claims 1 and 26 above, and further in view of Inumiya et al. (USPAT 6054355, Inumiya).

With regard to claims 13, Rodder discloses in figure 5, and column 4, lines 56 – 67 depositing a gate dielectric layer (110), and forming a gate electrode on the gate dielectric layer. Rodder does not disclose forming a dielectric layer that would be sufficient in Rodder, Sekine and Ishida because the dielectric layer of Rodder would not insulate the entire upper portion of the inner surface of the silicide regions of Rodder, Sekine and Ishida. Inumiya teaches in figure 10g depositing a gate dielectric layer (116) lining the inside of a groove (114) formed by the

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removal of an alignment feature, and forming a gate electrode (117) on the gate dielectric layer. It would have been obvious to one of ordinary skill in the art at the time of the present invention to use the gate dielectric layer of Inumiya in the method of Rodder, Sekine and Ishida in order to form a gate insulating film and a gate electrode in a groove formed by the removal of an alignment feature.

With regard to claims 14 and 31, it is further obvious in the method of Rodder, Sekine, Masuoka and Inumiya that the gate dielectric could be less than 10\AA thick. The gate dielectric could be less than 10\AA thick in order to facilitate the gate requirements for the decreasing dimensions of semiconductor devices.

With regard to claim 15, Rodder discloses that the gate electrode is made out of a metal in column 4, lines 64 – 67.

6. Claims 17 – 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rodder, Sekine, Ishida and Inumiya as applied to claims 1 and 13 above, and further in view of Gardner et al. (USPAT 6051865, Gardner).

With regard to claims 17 and 18, Rodder, Sekine, Ishida and Inumiya do not disclose using a high K dielectric layer. Gardner teaches in columns 3 and 4, lines 24 – 40 and 24-36 respectively a gate dielectric layer of barium strontium titanate that has a dielectric constant of at least 100. It would have been obvious to one of ordinary skill in the art at the time of the present invention to use the low K dielectric material of Gardner in the method of Rodder, Sekine, Ishida and Inumiya in order to decrease the transistor threshold voltage as stated by Gardner in column 3, lines 26 – 33.

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With regard to claim 19, Rodder, Sekine, Ishida, Inumiya and Gardner do not disclose using platinum as a gate electrode. It is well known in the art to form a gate electrode of platinum. It would have been obvious to one of ordinary skill in the art at the time of the present invention to use the platinum gate electrode in the process of forming a transistor of Rodder, Sekine, Ishida, Inumiya and Gardner in order to use a low-resistivity conductor for the gate material.

7. Claim 28 is rejected under 35 U.S.C. 103(a) as being unpatentable over Rodder, Sekine and Ishida as applied to claims 26 and 27 above, and further in view of Wolf (Silicon Processing for the VLSI ERA, Vol. 2).

Rodder, Sekine and Ishida do not disclose that the salicide is formed from cobalt. Wolf teaches on pages 150 – 152 a salicide formed from cobalt. It would have been obvious to one of ordinary skill in the art at the time of the present invention to use the cobalt salicide of Wolf in the method of Rodder, Sekine and Ishida in order to create an interface between the silicon and silicide that is smooth as taught by Wolf in the last five paragraphs on page 150.

Response to Arguments

8. Applicant's arguments filed January 25, 2002 have been fully considered but they are not persuasive. With regard to the argument that "Sekine teaches away from this suggested combination [of Sekine and Rodder]." It should be noted that the only teachings gleaned from Sekine are the steps and resulting characteristics of a silicide formed by the salicide process. The

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salicide process itself is taught by Rodder to form the silicide regions. Rodder is silent to the obvious features of this process, and therefore it is necessary to provide Sekine in order to show all of the features of forming a silicide and the features of the resulting silicide by the salicide process. Therefore, the combination of Rodder and Sekine is proper and the rejection stands.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Paul E Brock II whose telephone number is (703)308-6236. The examiner can normally be reached on 8:30 AM-5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie Lee can be reached on (703)308-1690. The fax phone numbers for the organization where this application or proceeding is assigned are (703)308-7722 for regular communications and (703)308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703)308-0956.

Paul E Brock II
March 18, 2002



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